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Architecture: A missing piece in real-estate studies of sustainable houses

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Abstract

In the era of ecological and economic crisis, while the trend has drastically changed, most single-family houses in the United States are still built in a conventional way. The problem has roots in the fact that ecologically sustainable buildings are often initially more costly compared to ordinary ones. In a number of studies, lower life-cycle cost and longer economic life of sustainable buildings have been considered as a beneficial effect on the cost, having a positive impact in the real estate market of green residential properties. On the other hand, there has been research discussing the impact of architecture and architectural decisions on real estate and marketing of the buildings. Yet a lack of research investigating the importance of architecture in the marketplace of green buildings especially homes is evident.

This study presents current literature and an analysis of the building appraisal process in different locations and mainly in the United States with special attention to the residential sector. The theoretical conclusion finds that architectural decisions can have a positive impact on the price of sustainable homes. This paper finally suggests direction for future research to be conducted in the interest of empirically proving this finding.

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1. Introduction

Environmental issues have raised serious concerns for several decades, yet little improvement has been realized in the building sector, especially in the single-family residential sector. In the US, buildings are responsible for more than 40% of national energy consumption [1] and for about 30% of greenhouse gas emissions [2]. On the one hand, buildings rely on natural resources and have large environmental footprints; on the other hand, they not only impact the environment, but also affect the humans they house. With the residential sector being an important part of building construction in the US, building new homes and retrofitting the old ones in a sustainable way is essential.

There are over 200 definitions available for sustainability [3]. The most prominent related to the built environment is the *Brundtland Report* where sustainable development addresses the needs of the present without comprising the needs of future generations [4]. Buildings that are built efficiently with a minimum negative impact on the environment during their life cycle are considered sustainable. Quite often, sustainable buildings are those that are eco-labeled for example U.S. Environmental Protection Agency (EPA) ENERGY STAR, U.S. Green Building Council (USGBC) LEED® (Leadership in Energy and Environmental Design), National Association of Home Builders (NAHB) NAHB Green and Passive House Institute US (PHIUS) Passive House Certificate. This paper does not intent to limit sustainable residential buildings to those that are "Green" certified. For the means of this study, any decision or feature that promotes a building from conventional to a more environmental considerate one could be deemed as sustainable. These could range from installing energy efficient equipments and orienting the house in north-south direction in order to benefit from southern exposure to more rigorous actions toward sustainability such as installing solar panels and building the homes out of recycled materials.

There is almost no doubt in the importance of sustainable housing. However, there are some obstacles in the way of its dominance. For example sustainable homes are believed to cost more to construct and generally clients are unwilling to initially invest more to purchase them. These are primary reasons that investors are usually hesitant to invest in sustainable projects. According to a McGraw-Hill *Smart Market Report*, higher upfront cost is one of the main restraints in increase of green building activity [5]. In addition, the industry is more experienced in conventional housing making that approach relatively less risky and more desirable.

In this situation, marketing of sustainable homes becomes essential. To date, most of the marketing emphasis in this sector is placed on technical aspects of green homes such as low energy bills and investment payback. While these topics are highly important, one of the other important aspects of sustainable homes, which is their architectural design, is usually neglected. Architectural design, or simply design in this paper, covers a vast variety of decisions in a project including orientation, window placements, space configuration, choice of finishing materials and so on. Design can serve as a derivative for clients and investors of sustainable houses. For example if people know that they can save about 25% on energy bills just by buying a house that is correctly solar orientated, they will get motivated to select that house over the same house with wrong orientation [6].

While a number of studies have discussed the effect of sustainable certificates and amenities on the value of properties, little attention has been given to the design aspect of these buildings. This is an opportunity for further research, especially since there have been other studies that correlate good design and architectural features with increased property values. The goal of this paper is to build on these two separate bodies of literature and address a gap where research is needed to evaluate the effect of architecture on the value of sustainable houses.

As observed through this study, hedonic pricing is the most common method for evaluating different variables on property values is hedonic pricing model. In this model, the value of the item being researched is considered to be a function of a number of variables where a change in the amount of a variable would change the value of the original item. The hedonic model decomposes the item into its constituents helping the value of each variable being revealed [6, 7]. Hedonic pricing is based on regression analysis which is a statistical calculation for estimating the relationships of different variables. Using independent and dependent variables, regression analysis keeps all the variables fixed except for one, allowing researchers to monitor how the value of dependent variable changes based on a change in value of the independent variable [8]. In real estate analysis, hedonic pricing provides a model for understanding the impact of common variables such as size, age and location and less prevalent variables such as mechanical systems, provisions for solar energy, or even architectural style on the price of a property.

This model can be used to determine the effect of different architectural features on the value of a sustainable house. One of the obstacles in such research is defining "sustainable homes" and "architecture". In the previous

research, sustainable homes have been viewed mostly as those that are certified with a "green" or "eco" label, though many of the homes that can be categorized as sustainable or as having sustainable features have not been certified. The issue is further complicated in the case of defining good architecture as it requires evaluating a qualitative subject with quantitative methods. Previously, parameters like style, view, and some architectural elements such as balconies or high ceilings have been factors that researchers considered to run hedonic or other statistical analysis. Before running any regression analysis, there is the need to define unique architectural features of green homes and prioritize them. While each aesthetically pleasant building is unique it's possible to address a few common features in those that have sought to meet ecological constrains. Providing natural light, using regional and sustainable materials, designing rain gardens and preserving the natural elements of the site are examples of sustainable design elements [9].

In the next section, an overview of the literature on the effect of sustainable features, decisions and amenities on property value is provided. Then the relationship between design and the market is investigated. The majority of the literature reviewed considered commercial buildings each section starts with research on commercial and office buildings and then discusses the studies related to residential sector. In the final section, lessons that can be learnt and the gaps in the current research are discussed.

2. Real Estate and Sustainability

The literature in real estate has predominantly focused attention on commercial buildings in the United States and beyond. A number of these studies have focused on the necessity of a defining goals and values of sustainability in real estate. Myers, Reed and Robinson (2008) study commercial buildings in New Zealand and argue that one of the obstacles for construction of sustainable buildings is the absence of market evidence and detailed sales and lease transactions which restricts the feasibility of sustainable projects for investors. They urge researchers to come up with viable evidence for profitability of sustainable projects and make a business case for them [10].

One of the topics that numerous studies have discussed is the effect of eco-labeling on property values. Dermisi (2009) studied the effect of the USGBC LEED® rating system on assessed and market value of offices in the United States. She used assessor-generated values from the CoStar Group, USGBC and County/City Assessors and Treasurers websites across the U.S. to evaluate 351 office buildings in 36 states. From this information regression analysis was used to determine the impact of different variables such as area, age, LEED® and ENERGY STAR certification. The research concludes that ENERGY STAR certification has a considerable positive impact on both assessed and market value of buildings while the effects of LEED® varies based on the level of certification and geographic aggregation [11]. In a 2011 research report Das, Tidwell and Ziobrowski used CoStar and USGBC data from 2007 through 2010 in the San Francisco and Washington DC areas to study rental rate dynamics of certified green office properties in these two cities. They found that there is a rental premium for green office properties; however, green premiums are not static. Instead, in order to offset negative effects of down-markets, the rents are stabilized in many conditions of the real estate market [12].

Another approach that has been taken in the market evaluation of green commercial buildings is analysis of investment risk. Jackson (2009) used empirical evidence from CoStar and uses Net Present Value (NPV), Internal Rate of Return (IRR) and riskiness analysis to evaluate risk and return associated with LEED® or ENERGY STAR certified green buildings. He finds that compared to LEED, ENERGY STAR adds less upfront cost to the project, is slightly less risky and provides slightly more financial benefit for the project [13].

While the amount of research conducted in housing sector is considerably less, there are a number of real estate studies that address the residential market. In an article evaluating the effect of ENERGY STAR certification on green houses, Bloom, Nobe and Nobe (2011) studied a sample of 300 homes in Fort Collins, Colorado consisting of 150 ENERGY STAR qualified homes and compared them to 150 non-ENERGY STAR qualified homes using hedonic regression analysis. They concluded that ENERGY STAR homes initially sell for approximately $93.22 per square meter ($8.66 per square foot) more than conventional ones [14]. Two years later (2013) Yoshida and Sugiura used transaction prices of 1,452 green projects and 10,481 non-green ones in Tokyo. They reported that the initial transaction premium of green buildings might be negative due to higher expected maintenance costs of these

buildings. However, the premium becomes positive after two years due to slower depreciation of green buildings [15].

In a 2011 study from the demand side, Goodwin analyzed responses from 9,138 survey respondents from the 2009 NAR (National Association of Realtors) Home Buyer and Seller Survey about the importance of green home amenities. He found that sustainable amenities are more important for first-time homebuyers and those who buy a home through its first transaction. In addition, these amenities were of less importance for homebuyers under 40 compared to those older than 40 [16].

In conclusion, these studies show that there is generally a price premium associated with green amenities and sustainable buildings including homes. However the premium is not always predictable as was seen in the comparison where LEED® certification was valued to be less beneficial than ENERGY STAR in the residential sector.

In the following section a similar approach to the review of recent literature has been used to evaluate the impact of design on conventional buildings.

3. Real Estate And Architecture

Architecture and design related features are not easy to quantify with a measurable variable and therefore are generally not being considered during appraisals and in hedonic pricing models of homes [17]. The cost-side of hiring architects and associated good design has received better attention than the demand-side [18] That being said, many studies have linked architecture to the value of buildings and they mostly have found a positive relation between good design and the value of properties.

In one of the earliest, Hough and Kratz (1983) assessed the effect of "good" architecture on 135 office spaces' rents in downtown Chicago using regression analysis [19]. Their measure of good architecture falls into two categories: Landmark status for older structures and Chicago American Institute of Architects (CAIA) jury award recipient projects for new buildings. The paper concludes that there is a 22% rent premium for good new architecture of CAIA award projects, while there is a price discount when the building is a landmark, perhaps since the process of renovation and making changes in the building is difficult and requires permission of the city government [19]. While the premium was unexpectedly significant at the time, the paper was criticized for not providing cost information by Vendell and Lane. In 1989 they evaluated 102 office buildings in Boston and Cambridge to understand the effect of good architecture on their construction costs, rent levels and vacancy rates [18]. In providing a measure for good architecture they surveyed architects and used disaggregation analysis. They found that there is a strong positive relationship between rent levels and good architecture but a weak relation between vacancy rates and the design. They also acknowledged that good design usually costs more but that is not necessarily the case [18].

Smith and Moorhouse (1993) also studied the effect of architecture on residential sector prices in Boston. Their regression analysis considered variables of lot and house size, neighborhood characteristics, construction materials, architectural style, and individual architectural features and found that in total, these features account for 14% of the price. Their findings, again, support the notion that architecture and planning can have a positive impact on property values [20].

Internationally, there are bodies of literature discussing architecture's effect on the value of buildings. In a 2006 housing study, Latvia, Plaut and Uzulena also used hedonic pricing to evaluate which style of architecture is more popular to the extent that people are willing to pay a price premium. Using data from 3500 transactions that took place between 1997 and 2003, they ran regression analysis to determine the impact of different architecture styles on the value of the homes. They concluded that new or renovated units have higher-value coefficients and there are premiums associated with some features such as brick material, high ceilings or having balconies [17].

4. Conclusion: Real Estate, Sustainability and Architecture

As can be seen from the literature discussed above, many studies have attempted to connect "sustainability," on one hand, and "architectural design," on the other, to property value. Most of these however, are focused on commercial buildings and less attention has been given to the residential sector. In addition, since the subject of

sustainability is a rapidly evolving one, a lot of the existing literature is outdated and needs to be revised or re-assessed. Moreover, evident from Jackson's study of the risk of sustainable real estate projects, the relationship between sustainability and property value is not always predictable [13]. Similarly, for the case of architecture, the price discount associated with landmarks was not obvious at first and needed empirical evidence to be proven [19].

Good architecture could be a derivative for people to buy sustainable homes. While many argue that good architecture adds to the costs of the project, especially in the case of the U.S. residential sector where most homes do not involve an architect, it is valuable to assess the validity of this statement. As discussed by some people cited in this paper, good architecture is not only necessarily more expensive [10]. Good design such as passive solar features, fitting the house with the prevailing views, and using local materials may add to the financial value of sustainable houses and result in price premiums. When it comes to investors, it's extremely important to have realistic data analysis showing that the investment is profitable and not overly risky.

There is a lack of recent literature analyzing the impact of good design on the value of sustainable houses. The method that has been used to find out the impact of single elements on the price has been predominantly hedonic regression analysis, while some have used other methods such as surveys. While there have been discussions on value of good architecture [21], a detailed transaction analysis is something important that is still missing. The authors of this paper will address this missing piece in a future study where through defining sustainable houses and categorizing design elements that serve sustainability and running the hedonic pricing model on a number of housing projects with and without the defined sustainable elements.

This research will be helpful in establishing clarified and detailed evidences on the impact of valuable sustainable architecture on the residential market. While this relation is expected to be positive it is important to support the idea through real estate analysis. One of the projected outcomes of such a study is to assess the types of design decisions that would result in a price premium and which ones will actually have negative effects on the initial home value.

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